

## **CLAIMS**

1. An apparatus for injecting an active product comprising a reserve (2) of working liquid pressurized by a pressurized liquid generator (3), a handpiece (5) terminating in an active extremity (8) that comprises an outlet means for a pressurized jet of working liquid and a jet of active product, characterized in that it comprises:

- ° a principal fluid circuit branch (4) connecting the reserve of working liquid (2) to the handpiece (5), with the flow of liquid through the branch being controlled by the opening or closing of an isolation valve (22);
- ° a secondary derivation branch (15) parallel to the principal branch (4) and fluidly isolated from it, designed to contain active product, with flow through this branch being controlled by the opening or closing of an isolation valve (23);
- ° a multiplexing means (24) for independent control of the opening and closing of the isolation valves (22, 23) according to predetermined parameters.

2. An apparatus according to claim 1 characterized in that it comprises a multiplexing means (24) for independent control over the opening and closing of the isolation valves (22, 23) according to any predetermined parameters previously selected and stored by the surgeon as a function of the particular case to be treated.

3. An apparatus according to any one of the preceding claims characterized in that the reserve (2) of working liquid is a flexible plastic pouch containing the working liquid and in that the generator (3) of pressurized liquid is an enclosure surrounding the reserve (2) of working liquid which is filled with neutral gas until it is pressurized sufficiently to compress the pouch and pressurize the liquid.

4. An apparatus according to an one of the preceding claims characterized in that the active extremity (8) is a catheter (9).

5. An apparatus according to the preceding claim characterized in that the catheter (9) comprises at its distal extremity a retractable perforating or puncturing tool movable between an extended working position and a retracted safety position inside the catheter.

6. An apparatus according to the preceding claim characterized in that the catheter (9) has at its distal extremity a retractable perforating or puncturing tool that is movable and has a retractable needle.

7. An apparatus according to any one of the preceding claims characterized in that it comprises a suction system (13) connected to a vacuum source (14).

8. An apparatus according to any one of the preceding claims characterized in that an anti-return flow control device (21) is located at the outlet of the principal branch (4).

9. An apparatus according to any one of the preceding claims characterized in that the secondary derivation branch (15) is isolated from the principal branch (4) by means of two anti-return flow control devices (19, 20) attached to the two extremities of the derivation tube.

10. An apparatus according to any of preceding claims 1 or 8 or 9 characterized in that the isolation valves (22) and (23) are attached at the immediate proximity, respectively, of anti-return flow control devices (21) and (20).

11. An apparatus according to the preceding claim characterized in that the anti-return flow control devices (20) and (21) are integrated within isolation valves (23) and (22), respectively.

12. An apparatus according to any one of the preceding claims characterized in that the secondary derivation branch (15) is connected to a reserve of active product (16) by a communicating device (17).

13. An apparatus according to the preceding claim characterized in that the communicating device (17) is a charge valve (18) with two or three tracks.

14. An apparatus according to any of claims 1 through 11 characterized in that the derivation branch (15) comprises a tubular portion (30) serving as a reserve that is calibrated for one precise dose of active product.

15. An apparatus according to any one of the preceding claims characterized in that the secondary derivation branch (15) comprises a tubular portion or restriction (33) having a reduced interior diameter, used to break the pressure of the liquid passing through it.

16. An apparatus according to the preceding claim characterized in that the tubular portion or restriction (33) of reduced interior diameter is located at the inlet to the secondary derivation branch (15) before the anti-return flow control device (19).

17. An apparatus according to any one of the preceding claims characterized in that at least one of the valves (22, 23) on the two circuit branches comprises a cam-shaped roller which, when closed, , crushes the tube from the outside.

18. An apparatus according to any one of the preceding claims characterized in that all the elements on the fluid circuit that could become contaminated are sterile, disposable, single-use elements.

19. An injection method using the injection apparatus according to any one of the preceding claims characterized in that a hollow injection channel is formed by blasting a jet of pressurized working liquid, and then in the next step the active product is injected through the injection channel.

20. A method of generating a sequence of liquid jets using an apparatus comprising a reserve (2) of working liquid pressurized by a pressurized liquid generator (3), a handpiece (5) terminating in an active extremity (8) comprising outlet means for a jet of pressurized working liquid and a jet of active product, a principal fluid circuit branch (4) connecting the reserve of working liquid (2) to the handpiece (5), with the flow of liquid through the branch being controlled by opening or closing an isolation valve (22), a secondary derivation branch (15) parallel to the principal branch (4) and fluidly isolated from it, designed to contain an active

product, with the flow of liquid through it being controlled by opening or closing an isolation valve (23), and a multiplexing means (24) for independent control over the opening and closing of the isolation valves (22, 23) according to predetermined parameters, characterized by generating a sequence consisting of at least one impulse of pressurized working liquid followed by a microscopically dosed impulse of active product.

21. A method of generating a sequence of liquid jets according to the preceding claim characterized in that the valve (22) on the principal branch (4) on the circuit is opened to generate an impulse formed of an appropriate quantity of pressurized working liquid, and then in a later phase valve (23) on the derivation branch (15) is opened to generate an impulse formed of the desired quantity of active product.

22. A method of generating a sequence of liquid jets according to claim 20 or 21 characterized in that the impulse of active product is generated at a pressure which essentially corresponds to that of the impulse of working liquid.

23. A method of generating a sequence of liquid jets according to claim 20 or 21 characterized in that the impulse of active product is generated at less pressure than that of the working liquid and preferably at low pressure.

24. A method of generating a sequence of liquid jets according to any one of claims 20 through 23 characterized in that the impulse of active product is followed by another impulse of pressurized working liquid.

25. A method of generating a sequence of liquid jets according to any one of claims 20 through 24 characterized in that the quantities of liquid forming the impulses of working liquid and active product are precisely established by fixing the opening time of each of the valves (22, 23).

26. A method of generating a sequence of liquid jets according to the preceding claim characterized in that the opening time of the valves (22, 23) varies as a function of the viscosity of the liquids.

27. A method of generating a sequence of liquid jets using an apparatus comprising a reserve (2) of working liquid pressurized by a pressurized liquid generator (3), a handpiece (5) terminating in an active extremity (8) comprising outlet means for a pressurized jet of working liquid and a jet of active product, a principal fluid circuit branch (4) connecting the reserve of working liquid (2) to the handpiece (5), with the flow of liquid through it being controlled by the opening or closing of an isolation valve (22), a secondary derivation branch (15) parallel to the principal branch (4) and fluidly isolated from it, designed to contain active product, with the flow of liquid through it being controlled by the opening or closing of an isolation valve (23), and a multiplexing means (24) to independently control the opening and closing of the isolation valves (22, 23) according to predetermined parameters, characterized in that the two valves (22, 23) of the two branches (4, 15) of the circuit are opened simultaneously in order to generate a jet consisting of a mixture of active product and working liquid in proportions that are precisely fixed by regulating the opening time of each of the valves (22, 23).

28. A method of generating a sequence of liquid jets according to any one of claims 20 through 27 characterized in that a very small quantity of active product is used and it is used in microscopic doses.

29. A method of generating a sequence of liquid jets according to any one of claims 20 through 28 characterized in that it comprises the following steps:

- ° purging air from the apparatus in order to fill it with working liquid;
- ° charging the apparatus with active product;
- ° preparing one or more blasts by successively disposing packets of fluid in the appropriate order and quantity and placing them in blasting position at the active distal extremity of the apparatus just before the outlet orifice;
- ° placing the active distal extremity of the apparatus in blasting position;
- ° performing at least one blast of a series of liquid jets.